
REMARKS

This communication is a full and timely response to the Office Action dated October 14, 2003. By this communication, Applicants have canceled claims 8, 43, and 53-111, and amended claims 1-7, 9-42, and 44-52. Claims 2-7, 9-22, 24, 26-42, and 44-52 were amended to improve form.

Claim 1 has been amended to recite, among other thing, wherein said chelate film is removed by wiping or mechanical polishing. Support for the changes to claim 1 can be found variously throughout the specification and the drawings. For example, support for the changes to claim 1 can be found in original claim 8, in Fig. 5J, and in the specification at page 40, lines 20-25. Claim 23 has been amended to recite, among other thing, wherein said chelate film is removed by wiping or mechanical polishing. Support for the changes to claim 23 can be found variously throughout the specification and the drawings. For example, support for the changes to claim 23 can be found in Fig. 5J and in the specification at page 40, lines 20-25. In addition, claim 25 has been amended to recite, among other thing, wherein said chelate film is removed by wiping or mechanical polishing. Support for the changes to claim 25 can be found variously throughout the specification and the drawings. For example, support for the changes to claim 25 can be found in Fig. 5J and in the specification at page 40, lines 20-25. No new matter has been added. Claims 1-7, 9-42, and 44-52 are pending, where claims 1, 23, and 25 are independent.

Rejections Under 35 U.S.C. §103

Claims 1-5, 9-18, 21-42, and 46-52 were rejected under 35 U.S.C. §103(a) as unpatentable over *Wang*, U.S. Patent No. 6,440,295, in view of *Stevens et al.*, U.S. 6,331,490. As noted above, claims 8 and 43 were canceled, and the elements of claim 8 has been incorporated into claim 1, and the elements of claim 43 have been incorporated into claim 25. As a result, the rejection with respect to claims 8 and 43 is moot, and the rejection of claim 8 and 43 in view of *Basi*, U.S. Patent No. 3,951,710 will be addressed with respect to claims 1 and 25. Applicants respectfully traverse this rejection.

Independent claim 1 recites a method for producing a semiconductor device, comprising the steps of forming an interconnection groove in an insulation film formed on a substrate; stacking a copper film having unevenness on its surface corresponding to the step difference of the interconnection groove on the entire surface of the insulation film so as to bury the interconnection groove; interposing an electrolytic solution comprising a chelating

agent between a cathode member and the copper film functioning as an anode; applying a voltage between the cathode member and the copper film to oxidize the surface of the copper film by anodic oxidation forming a chelate film of oxidized copper; selectively removing a projecting portion of the chelate film corresponding to unevenness of the copper film to expose the copper film of the projecting portion at its surface, wherein said chelate film is removed by wiping or mechanical polishing; and repeating the above chelate film forming step and the chelate film removing step until the projecting portion of the copper film is flattened.

Claim 23 recites a polishing method for polishing an object having a copper film on the surface to be polished, comprising the steps of interposing an electrolytic solution including a chelating agent between a cathode member and the surface to be polished; applying a voltage between the cathode member functioning as a cathode and the surface to be polished functioning as an anode to oxidize the surface of the copper film and forming a chelate film of oxidized copper; selectively removing a projecting portion of the chelate film corresponding to the shape of the copper film to expose the copper film of the projecting portion at its surface, wherein said chelate film is removed by wiping or mechanical polishing; and repeating the above chelate film forming step and the chelate film removing step until the projecting portion of the copper film is flattened.

Claim 25 recites a method for production of a semiconductor device, comprising the steps of forming at least a groove or hole in an insulation film formed on a substrate; stacking a metal film on said insulation film so as to bury the groove or hole; interposing an electrolytic solution between a electrode member and the metal film; oxidizing the surface of the metal film through an anode oxidation process; forming a chelate film of oxidized copper on the oxidated metal film; removing the chelate film from the surface of the metal film, wherein said chelate film is removed by wiping or mechanical polishing; and selectively repeating the above step of removing the chelate film until the unevenness of the surface of the metal film is reduced.

Applicant notes that each of claims 1, 23, and 25 recite said chelate film is removed by wiping or mechanical polishing. The chelate film is removed in this manner because of the insolubility of the chelate agent, thus the chelate film cannot be removed by a solution.

Wang discloses a method for electropolishing a surface of copper by ionizing and dissolving the solid copper. In this process, a dielectric layer 123 is formed on top of a substrate 124. A damascene process is then performed so that trenches 125 and gates 126 can

be formed in the dielectric layer 123. Next, a barrier layer 122 is formed on top of the dielectric layer 123. Alternatively, *Wang* discloses that a metal layer 121 can be formed on top of the barrier layer 122 or formed on top of the dielectric layer 123. The metal layer is then electropolished. Electropolishing is performed by controlling the polarity of cathodes 1-3 and by controlling the portions of the wafer contacted by an electrolyte 34. The uniformity and rate of polishing is controlled by the amount of current supplied by power supplies 11-13. The wafer is electropolished until the metal layer 121 is removed from the barrier layer 122, while the metal layer 121 remains within the trenches 125. See col. 7, lines 1-col. 8, line 25, col. 9, line 64-col. 10, line 16, col. 10, line 61-col. 12, line 14. The Office Action acknowledges that *Wang* fails to disclose teach or suggest at least applying a voltage between the cathode and the copper film to oxidize the surface of the copper film by anodic oxidation and form an oxidized copper film/chelating film. In addition, Applicants note that *Wang* further fails to disclose, teach, or suggest said chelate film is removed by wiping or mechanical polishing.

Stevens discloses a process for forming a water soluble chelate film of a copper by anodic oxidation and removing the chelate film in the solution. In this process, a plurality of transition layers 40 and 45 are formed at the interface between the tantalum barrier layer 20 and silicon oxide layer 15 and at the interface between the tantalum barrier layer 20 and copper layer 25, respectively. The copper layer 25 is oxidized to form copper oxide 50 at exposed regions of the copper layer 25. After being selectively oxidized, the copper layer 25 is subject to an etchant that selectively removes the oxidized material while leaving the non-oxidized portions of the layer relatively intact. See col. 5, lines 11-36, Fig. 3. While *Stevens* does teach that the copper layer 25 is selectively oxidized, *Stevens* fails to disclose, teach, or suggest said chelate film is removed by wiping or mechanical polishing. In fact, *Stevens* discloses that the copper layer 25 is subject to an etchant that selectively removes the oxidized material while leaving the non-oxidized portions of the layer relatively intact.

The Office Action acknowledged that *Wang* and *Stevens* fails to disclose, teach, or suggest the step of removing the oxidized copper/chelating film by wiping.

Basi discloses a method of wiping contamination from a semiconductor surface in a CMP technology. In particular, *Basi* discloses a conventional process of wetting a silicon substrate with an excess quantity of displacement solution, and continually wiping the wet substrate surface. *Basi* fails to disclose, teach, or suggest an electro-polishing process as recited in the claims.

In sum, even if the subject matter of *Wang*, *Stevens*, and *Basi* could be combined, their combination still would not disclose, teach, or suggest said chelate film is removed by wiping or mechanical polishing. At best, the combination of *Wang*, *Stevens*, and *Basi* discloses the oxidation of a copper film on a substrate, and removing the oxidized copper by applying an etchant, or alternatively applying a plating solution of copper to the copper film and wiping the film to remove the excess quantity. Moreover, *Basi* fails to disclose, teach, or suggest a motivation for combining the aforementioned teachings with those of *Wang* and *Stevens*. Thus, the Office Action has not established a *prima facie* case for obviousness.

To establish *prima facie* obviousness of a claimed invention, all of the claim limitations must be taught or suggested by the prior art. *In re Royka*, 490 F.2d 981, 180 USPQ 580 (CCPA 1974). Moreover, obviousness "cannot be established by combining the teachings of the prior art to produce the claimed invention, absent some teaching or suggestion supporting the combination." *ACS Hosp. Sys. V. Montefiore Hosp.*, 732 F.2d 1572, 1577, 221 USPQ 929, 933 (Fed. Cir. 1984). For at least these reasons, Applicants submit that the Office Action has failed to establish a *prima facie* case for obviousness. Thus, Applicants respectfully request that the rejection of claims 1, 23, and 25 under 35 U.S.C. §103 be withdrawn, and these claims be allowed.

Claims 2-5, 9-18, 21, and 22 depend from claim 1, claim 24 depends from claim 23, and claims 26-42, and 46-52 depend from claim 25. By virtue of this dependency, Applicants submit that claims 2-5, 9-18, 21, 22, 24, 26-42, and 46-52 are allowable for at least the same reasons given above with respect to their respective base claims. In addition, Applicants submit that claims 2-5, 9-18, 21, 22, 24, 26-42, and 46-52 are further distinguished over *Wang* and *Stevens* by the additional elements recited therein, and particularly with respect to each claimed combination. Applicants respectfully request, therefore, that the rejection of claims 2-5, 9-18, 21, 22, 24, 26-42, and 46-52 under 35 U.S.C. §103 be withdrawn, and these claims be allowed.

Claims 6 and 7 were rejected under 35 U.S.C. §103(a) as unpatentable over *Wang* in view of *Stevens* and father in view of *Liu*, U.S. Patent No. 5,963,040. Applicants respectfully traverse this rejection

Claims 6 and 7 depend from claim 1. By virtue of this dependency, Applicants submit that claims 6 and 7 are allowable for at least the same reasons given above with respect to their respective base claims. In addition, Applicants submit that claims 6 and 7 are further distinguished over *Wang*, *Stevens*, and *Liu* by the additional elements recited therein,

and particularly with respect to each claimed combination. Applicants respectfully request, therefore, that the rejection of claims 6 and 7 under 35 U.S.C. §103 be withdrawn, and these claims be allowed.

Claims 8 and 43-45 were rejected under 35 U.S.C. §103(a) as unpatentable over *Wang* in view of *Stevens*, and further in view of *Basi*, U.S. Patent No. 3,951,710. Because claims 8 and 43 have been canceled the rejection with respect to these claims is moot. With regards to claims 44 and 45, however, Applicants respectfully traverse this rejection.

Claims 44 and 45 depend from claim 25. By virtue of this dependency, Applicants submit that claims 44 and 45 are allowable for at least the same reasons given above with respect to their respective base claims. In addition, Applicants submit that claims 44 and 45 are further distinguished over *Wang*, *Stevens*, and *Basi* by the additional elements recited therein, and particularly with respect to each claimed combination. Applicants respectfully request, therefore, that the rejection of claims 44 and 45 under 35 U.S.C. §103 be withdrawn, and these claims be allowed.

Claims 19 and 20 were rejected under 35 U.S.C. §103(a) as unpatentable over *Wang* in view of *Stevens*, and further in view of *Degani*, U.S. Patent No. 5,904,859. Applicants respectfully traverse this rejection.

The Office action acknowledged that *Wang* and *Stevens* fails to disclose, teach, or suggest, using phosphoric as a chelating agent instead of citric acid.

Degani discloses using a citric acid or a phosphoric acid as a chelating agent in a chemical reaction for etching a copper/chromium layer on a substrate. *Degani*, however, fails to disclose, teach, or suggest, that this process is also part of an electrochemical reaction. Neither, does *Degani* disclose, teach, or suggest a motivation for including this chemical reaction in an electrochemical reaction.

In sum, even if the *Wang*, *Stevens*, and *Degani* could be combined the resulting process still would not achieve the results of the claimed invention. At best, this combination discloses the oxidation of a copper film on a substrate by applying a citric acid or phosphoric acid, and removing the oxidized copper by applying an etchant. In particular, the combination fails to disclose teach or suggest said chelate film is removed by wiping or mechanical polishing. Thus, the Office Action has failed to establish a *prima facie* case for obviousness.

To establish *prima facie* obviousness of a claimed invention, all of the claim limitations must be taught or suggested by the prior art. *In re Royka*, 490 F.2d 981, 180

USPQ 580 (CCPA 1974). Moreover, obviousness “cannot be established by combining the teachings of the prior art to produce the claimed invention, absent some teaching or suggestion supporting the combination.” ACS Hosp. Sys. V. Montefiore Hosp., 732 F.2d 1572, 1577, 221 USPQ 929, 933 (Fed. Cir. 1984). For at least these reasons, Applicants respectfully request that the rejection of claim 19 and 20 be withdrawn, and these claims be allowed.

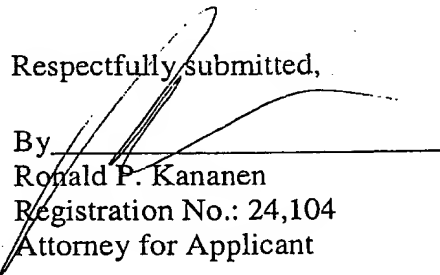
Conclusion

Based on at least the foregoing amendments and remarks, Applicants submit that claims 1-7, 9-42, and 44-52 are allowable, and this application is in condition for allowance. Accordingly, Applicants request favorable reexamination and reconsideration of the application. In the event the Examiner has any comments or suggestions for placing the application in even better form, Applicants request that the Examiner contact the undersigned attorney at the number listed below.

Applicant believes no fee is due with this response. However, if a fee is due, please charge our Deposit Account No. 18-0013, under Order No. SON-2043 from which the undersigned is authorized to draw.

Dated: December 22, 2003

Respectfully submitted,

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